

mington, N. C., northward, the highest velocity being 68 miles an hour from the northwest at New York City. Warnings were displayed well in advance of this storm.

The last storm warnings of the month were displayed from Cape Hatteras northward in advance of the disturbance that was central over Illinois the evening of the 30th and moved northeastward with increasing intensity over the southern Lake region and the St. Lawrence valley. The maximum wind velocity reported was 56 miles an hour from the northwest at New York City.

Cold wave warnings.—December was an unusually mild month in the Washington Forecast District. No cold-wave warnings were issued, except for portions of northern New England and northern New York, until near the close of the month. Warnings were issued for practically the entire district, except southern and central Florida and the Atlantic States north of Maryland during the last two days of the month, well in advance of the cold wave that swept rapidly southeastward from the Canadian Northwest over the Plains States and the Missouri and upper Mississippi valleys. However, the cold wave lost much of its intensity in the sections farther east and south and the warnings were fully verified only in Kentucky, Tennessee, and the interior of the east Gulf States.

Frost warnings were issued for portions of the South Atlantic and east Gulf coasts and Florida on the 5th, 6th, 13th, 14th, 16th, 23d, 24th, and 25th.—*Chas. L. Mitchell.*

CHICAGO FORECAST DISTRICT.

The month was warm throughout practically the entire forecast district, and precipitation was deficient, except in the Ohio Valley. There was very little snowfall, except in the northern and eastern portions of the Great Lakes region.

Cold wave warnings.—The only cold wave of the entire month pushed southeastward from Alaska to the Canadian Northwest Provinces by December 28, and this steadily moved southward and eastward over the entire Chicago district. Warnings were issued from one to three days in advance of the area of low temperature. The cold wave finally culminated in the first week of January in a period of lowest minima registered within a decade or more at many points.

Livestock warnings.—Livestock warnings were issued for the western ranges during the closing week of the month in advance of the severe cold wave, and press dispatches indicate that, because of these warnings, all exposed cattle were driven to points of shelter.

Storm warnings.—The storm-warning season terminated on December 15 on Lake Superior and on December 18 on the balance of the Great Lakes. Until the close of the season the Great Lakes were exceptionally free from storms of great violence. Warnings were issued for four different storms, with advices for strong winds, as the disturbances moved across the Great Lakes, and so far as known no loss was experienced by vessel interests.

Following the formal close of navigation, winter service was maintained upon Lake Michigan. The storm which ushered in the cold wave at the close of the month was accompanied by strong winds, and advices well in advance were sent to the open ports on the Lake.

Warnings to banana shippers.—A special warning service as an aid to the protection of bananas in transit was begun during the month, and advices were sent to selected points in the Middle West whenever warranted by conditions.

Special forecasts.—We were requested by Mr. S. B. Fracker, State entomologist, Department of Agriculture,

Madison, Wis., to issue a special forecast for certain points in Wisconsin whenever a temperature of minus 10° or lower was expected, for use in connection with tests being made with weevil-infested alfalfa. Special forecasts were sent on two dates, December 29 and 31, and apparently were highly satisfactory, as shown by the following excerpt from letter received from the Wisconsin Department of Agriculture:

I wish to thank you for the telegrams regarding low temperatures received from your office, signed by Mr. Donnel. They were of great value, as they enabled us to get in touch with the owners of the supposedly infested alfalfa and arrange for the exposure of the hay.

—*H. J. Cox.*

NEW ORLEANS FORECAST DISTRICT.

Severe weather conditions were lacking except on December 30 to January 1, when an area of high pressure moved southward behind an east-west trough, dividing the trough after causing it to assume a crescent shape. Unusually cold weather resulted in the interior sections and a "norther" on the Texas coast. Cold-wave warnings were issued well in advance of the low temperatures attending this anticyclone and were verified except in the coast sections of Louisiana and in the vicinity of El Paso, Tex. Northwest storm warnings were displayed on the 31st for strong northerly winds on the Texas and Louisiana coasts and moderate to fresh gales on the Texas coast. Winds occurred as forecast on the Texas and western Louisiana coasts but were weaker on the eastern Louisiana coast, as the pressure gradient diminished with eastward movement of the high pressure.

Small-craft warnings, displayed on the Texas coast on the 7th and 13th, were justified. "Norther" warnings were issued for Tampico, Mexico, on the 13th and 31st.

Frost or low-temperature warnings were issued for portions of the district on the 4th, 5th, 6th, 10th, 13th, 14th, 16th, 23d, and 24th, and were verified except where cloudiness prevented frost in the extreme southern sections on the 17th, 24th, and 25th.

Warnings were issued on the 10th, 29th, 30th, and 31st for livestock interests in portions of the district and were justified. A blizzard developed in West Texas on the 10th and continued into the 11th, with temperatures well below freezing in the northern and western portions. Fire-weather warnings were issued on the 7th for forested areas in Arkansas, Oklahoma, and Texas, and were also justified.—*R. A. Dyke.*

DENVER FORECAST DISTRICT.

On the 7th, when a low of unusual energy moved from Alberta to the northwestern portion of the Lake region, a secondary storm of great intensity developed over southeastern Wyoming and eastern Colorado, the center of which advanced southwestward to northeastern Arizona by the morning of the 8th and thence southward to Texas by the night of the 8th–9th. On the morning of the 8th, warnings of a moderate cold wave were issued for southwestern Colorado and extreme northwestern New Mexico "to-night" and for southeastern New Mexico the following day, Sunday, together with livestock warnings for southwestern Colorado and northwestern New Mexico. Warnings of a moderate cold wave in southeastern New Mexico were repeated at 8 p. m. of the 8th.

The cold-wave warning was fully verified in southwestern Colorado and northwestern New Mexico. While

the fall at Roswell amounted to 22° during the 24 hours ending at 8 p. m. Sunday, the minimum temperature on Monday morning was 28° or 8° above the verifying limit. Snow fell in northern New Mexico and eastern Arizona on the 8th-11th, with rain, turning to heavy snow, in extreme eastern and southern New Mexico on the night of the 9th-10th, the snow continuing through the 11th. Gales prevailed in central and western New Mexico on the 10th and 11th. According to newspaper reports, 11 persons lost their lives in northern New Mexico as a result of the storm, and hundreds of automobile tourists were unable to proceed across the northwestern portion of that State on account of the heavy snow.

Another storm began to develop over the southern Rocky Mountain Plateau on the 18th and was central over southern Nevada on the morning of the 19th. On the morning of the 20th, when the center was over northern Arizona, warnings of a moderate cold wave and livestock warnings were issued for southwestern Colorado, extreme northwestern New Mexico, north-central and northeastern Arizona, and southern Utah. On account of a decrease in intensity of the low, the cold-wave warning was verified in north-central and northeastern Arizona, only. Snow fell in all of the sections specified throughout the 20th and continued in northern New Mexico and southwestern Colorado until the night of the 21st-22nd.

Warnings of a moderate cold wave were issued on the evening of the 26th for northern and eastern Colorado, and on the morning of the 27th for Colorado, northern New Mexico, northern and central Arizona, and southeastern Utah, because of the southeastward movement of a low of considerable intensity which was central on the evening of the 26th over eastern Colorado and which on the morning of the 27th extended from the upper Lake region southwestward to northern Arizona, with the principal center over southern Iowa. Owing to the failure of the western extremity of the barometric trough to advance southward, and because of the development of a secondary storm over eastern Colorado on the 27th-28th, the warnings were not verified, although the temperature fell sharply on the western slope of Colorado.

During the 27th-29th a disturbance of decided intensity advanced southeastward from Alaska, with its center on the morning of the last-named date over Wyoming, while an area of high pressure, attended by a severe cold wave, occupied the extreme northeastern Rocky Mountain slope. Warnings of a severe cold wave and livestock warnings were issued for eastern Colorado on the morning of the 29th and extended to northeastern New Mexico at 2 p. m. of the same day. Warnings of a severe cold wave in eastern and central Colorado and northeastern New Mexico were repeated on the evening of the 29th, and on the morning of the 30th these were extended to include southeastern New Mexico. Warnings of a moderate cold wave were also issued on the morning of the 30th for western Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah, together with livestock warnings for southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah. The warning of a severe cold wave in southeastern New Mexico was repeated on the evening of the 30th, followed on the morning of the 31st by a further warning of a moderate cold wave in the same section.

These warnings were completely verified, except that the fall in temperature at Roswell between the mornings of December 31 and January 1 amounted to but

14°, with a minimum of 14°. Temperatures below zero extended to northeastern Colorado on the morning of the 30th and to all of southern Colorado and extreme northern New Mexico on the morning of the 31st. The cold wave was preceded or accompanied by snow in about all portions of the district except extreme southern New Mexico and southern Arizona, with heavy snow during the 30th in southwestern Colorado and northeastern Arizona.

A cold wave, without warning, occurred in north-central Colorado on the 13th, due to the eastward movement of a secondary depression which was central over the southeastern portion of the State on the morning of that date, and to the rapid southeastward advance of a high from the north Pacific slope. Local cold waves, also without warning, occurred at Roswell and Durango on the 23d.

Freezing temperatures were forecast for south-central Arizona on the 9th and 12th and for southeastern Arizona on the 13th and 31st. Warnings of heavy frost were issued for south-central Arizona on the 4th, 5th, 6th, and 23d; for south-central and southwest Arizona on the 9th and 12th; for southwestern Arizona on the 13th and 31st; for southern Arizona on the 20th, 21st, 22d, 25th, and 27th.

The temperature failed to reach the freezing point in the sections mentioned on the mornings of December 10 and 14 and January 31. As a rule, the frost warnings issued were verified by temperatures at which frost might be expected to occur.—*J. M. Sherier.*

SAN FRANCISCO FORECAST DISTRICT.

Although December was more stormy than usual in the north portion of the district, the rainfall was unusually light in the California valleys, and there was at the close of the month a marked deficiency in the amount of snow in the Sierra Nevada Mountains. Storms moved with considerable regularity across the northern boundary of Washington and Idaho, but only a small one entered the United States south of the Columbia River, and that was not till the next to the last day of the month. The most severe storms occurred on the 6th, with a maximum wind velocity of 84 miles from the south at North Head; 10th-11th, maximum wind Nelo city 76 miles south at Talovsh Island; 18th, maximum wind 80 miles south at North Head; and on the 25th, with a maximum wind velocity of 72 miles from the southwest at North Head. This Christmas storm also caused a maximum wind velocity of 68 miles from the south at Seattle, which is one of the most, if not the most severe wind ever experienced in that city. Storm warnings were issued for one or more places in the district on 17 days and in all cases well ahead of the occurrence of the high winds.

Although frost formed frequently in California and it was necessary to issue frost warnings on no less than 18 days, the damage done by them was not great, largely on account of the protective measures taken by the growers to prevent injury. A cold-wave warning was issued on the morning of the 30th to cover places in eastern Oregon, eastern Washington and Idaho. The temperature eventually reached the zero mark in these localities, but not soon enough to completely verify the forecast.

The stormy conditions in the north and the lack of precipitation in the south were due to persistent low pressure over Bering Sea and the Aleutian Islands, which made the northern track for storms the most feasible to take in their eastward movement.—*E. A. Beals.*